

# CO<sub>2</sub> Air Conditioning System

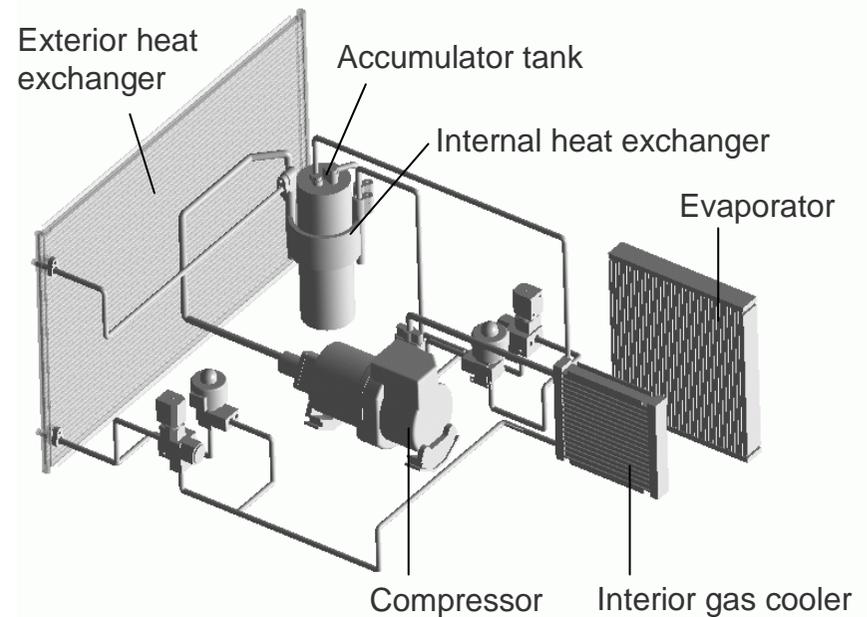
TECHNOLOGY

Freon-less car air conditioning using natural CO<sub>2</sub> refrigerant gas

## TECHNOLOGY Freon-less Car Air Conditioning System

In order to halt the progress of global warming, the refrigerant gas used in car air conditioning systems was changed from Freon to a substitute called HFC-134a. However, this new gas still has a significant effect on global warming, so in response, DENSO has developed a car air conditioning system that uses CO<sub>2</sub> as a refrigerant gas. CO<sub>2</sub> has a very low global warming index compared to those of conventional hydrofluorocarbon compounds, yet can perform well as a refrigerant gas when used at very high pressures.

Car air conditioning system using CO<sub>2</sub> as a refrigerant gas



**DENSO**

# CO<sub>2</sub> Air Conditioning System

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## TECHNOLOGY 1 CO<sub>2</sub> Refrigerant Gas

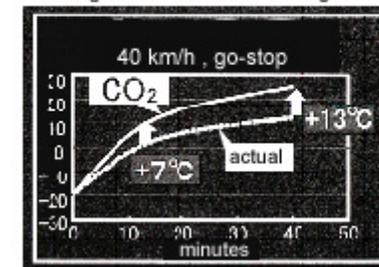
DENSO first came across the idea of using CO<sub>2</sub> as a refrigerant gas for car air conditioning systems in 1993 when Professor Lorenzen at the Norway Institute of Technology published a paper on the subject. At the time, a substitute for freon in air conditioning was being sought, and many different substitutes were proposed. However, the substitute adopted was still recognized as having a large effect on global warming, and many believed that in the future the use of some naturally occurring gas could be made practical. In 1995, actual research began and developments progressed until it was found that CO<sub>2</sub> had a global warming factor of only 1/1,300th of HFC-134a, and could be used as a refrigerant gas with a high efficiency heat pump. Thus, the merits of CO<sub>2</sub> were finally realized.

## TECHNOLOGY 2 High-pressure & Higher Efficiency

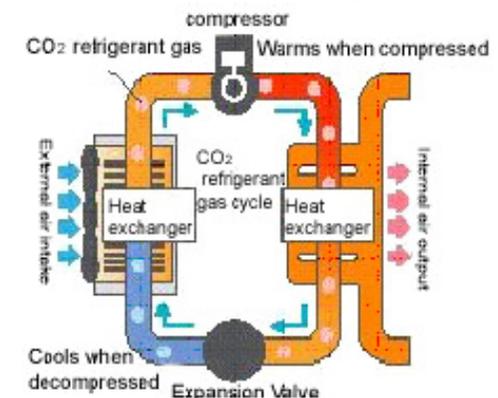
When CO<sub>2</sub> is pressurized and depressurized, heating and cooling functions occur. However, it is necessary to apply seven to 10 times more pressure than is required when using Freon gas. Accordingly, the components used in the system must be able to withstand these higher pressures. Other significant factors are reliability, weight, cost and so forth. DENSO was able to overcome these obstacles, and developed a CO<sub>2</sub> air conditioning system in 2001. In December 2002, the system was employed in Toyota's fuel cell vehicle.

## Heat pump performance

Warming characteristics at -20 degrees C



## Heat exchange cycle (when heating)



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